

Chapter C2: Evaluation of Impingement and Entrainment in the North Atlantic Region

BACKGROUND: NORTH ATLANTIC MARINE FISHERIES

Commercial and recreational fisheries of the North Atlantic region are managed by the New England Fisheries Management Council (NEFMC) according to Fishery Management Plans (FMPs) developed by NEFMC (NMFS, 2002a). The NMFS Northeast Fisheries Science Center provides scientific and technical support for management, conservation, and fisheries development.

The multispecies groundfish fishery is the most valuable commercial fishery of the North Atlantic region, followed by American lobster (*Homarus americanus*) (NMFS, 1999b). Important groundfish species include Atlantic cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*), yellowtail flounder (*Pleuronectes ferrugineus*), windowpane flounder (*Scophthalmus aquosus*), and winter flounder (*Pleuronectes americanus*). Atlantic pelagic fisheries are dominated by Atlantic mackerel (*Scomber scombrus*), Atlantic herring (*Clupea harengus*), bluefish (*Pomatomus saltatrix*), and butterfish (*Peprilus triacanthus*) (NMFS, 1999b). Important recreational fisheries of the region include Atlantic cod, winter flounder, Atlantic mackerel, striped bass (*Morone saxatilis*), bluefish, and bluefin tuna (*Thunnus thynnus*) (NMFS, 1999b).

Offshore fisheries for crustaceans and molluscs, particularly American lobster (*Homarus americanus*) and sea scallop (*Placopecten magellanicus*), are among the most valuable fisheries in the Northeast (NMFS, 1999b). Surfclams (*Spisula solidissima*), ocean quahogs (*Arctica islandica*), squids (*Loligo pealeii* and *Illex illecebrosus*), northern shrimp (*Pandalus borealis*), and red crab (*Chaceon quinque-dens*) also provide important invertebrate fisheries.

The Northeast lobster fishery is second in commercial value after the multispecies groundfish fishery. The most recent comprehensive stock assessment, completed in 1996, indicated that lobster fishing mortality rates for both inshore and offshore populations greatly exceed the levels needed to provide maximum yields (NMFS, 1999b). Lobster fishing mortality in the Gulf of Maine was almost double the overfishing level. Inshore from Cape Cod through Long Island Sound, fishing mortality was three times the overfishing level.

C2-1 FISHERY SPECIES IMPINGED AND ENTRAINED

Fifteen groundfish species making up 25 stocks are managed under the Northeast Multispecies FMP of the NEFMC (NMFS, 2002a). Stocks of another 12 North Atlantic species are under the jurisdiction of the ASMFC (NMFS, 2002a). Tables C2-1 and C2-2 summarize the status of these stocks, indicating in bold the stocks subject to impingement and entrainment (I&E). In these tables, overfishing refers to the condition when fishing mortality is above a management threshold, jeopardizing the long-term capacity of the stock to produce the potential maximum sustainable yield on a continuing basis. A stock is considered overfished when biomass falls below a given threshold. In some cases, heavy fishing in the past may have reduced a stock to low abundance, so that it is now considered overfished even though the stock is not currently subject to overfishing.

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Table C2-1: Summary of Stock Status for Harvested Species of the North Atlantic Region Included in Federal Fishery Management Plans				
Stock (Species in bold are subject to I&E)		Overfishing? (Fishing mortality above threshold)	Overfished? (Biomass below threshold)	Approaching Overfished Condition?
Cod	Gulf of Maine	Yes	Rebuilding	No
	Georges Bank	No	Rebuilding	No
Haddock	Gulf of Maine	Yes	Rebuilding	No
	Georges Bank	No	Rebuilding	No
American plaice		Yes	No	No
Redfish (ocean perch)		No	Yes	N/A
Witch flounder		No	No	No
Yellowtail flounder	Georges Bank	No	No	No
	Southern New England	No	Yes	N/A
	Cape Cod	No	Rebuilding	No
	Middle Atlantic	Yes	Yes	N/A
White hake		Yes	Yes	N/A
Pollock		Unknown	Unknown	Unknown
Ocean pout		No	Yes	N/A
Atlantic halibut		Unknown	Yes	N/A
Windowpane flounder	Gulf of Maine/Georges Bank	No	No	No
	Southern New England/Middle Atlantic	No	No	Yes
Winter flounder	Gulf of Maine	Unknown	Undefined	Unknown
	Georges Bank	No	Rebuilding	No
	Southern New England	No	No	No
Silver hake	Gulf of Maine/Northern Georges Bank	Unknown	Rebuilding	No
	Southern Georges Bank/Middle Atlantic	Unknown	Yes	N/A
Offshore hake		Unknown	Unknown	Unknown
Red hake	Gulf of Maine/Northern Georges Bank	No	No	No
	Southern Georges Bank/Middle Atlantic	No		Unknown

Source: Table 4 in NMFS (2002a).

Table C2-2: Summary of Stock Status of Harvested Species of the North Atlantic Region Under AFSMC Jurisdiction and Not Included in Federal Fishery Management Plans

Stock (Species in bold are subject to I&E)	Overfishing? (Fishing mortality above threshold)	Overfished? (Biomass below threshold)	Approaching Overfished Condition?
American eel	Unknown	Unknown	Unknown
American lobster	Yes	Undefined	Unknown
Atlantic croaker	Unknown	Unknown	Unknown
Atlantic menhaden	No	No	Unknown
Atlantic sturgeon	No	Yes	N/A
Horseshoe crab	Unknown	Unknown	Unknown
Northern shrimp	Yes	Undefined	Unknown
Spot	Unknown	Unknown	Unknown
Spotted seatrout	Unknown	Unknown	Unknown
Striped bass	No	No	Unknown
Tautog	Yes	Undefined	Unknown
Weakfish	Undefined	No	No

Source: Table 6 in NMFS (2002a).

As indicated in Table C2-1, seven of the 25 stocks managed under the Northeast Multispecies FMP are classified as overfished, including redfish (*Sebastes* spp.), the southern New England and Middle Atlantic stocks of yellowtail flounder, white hake (*Urophycis tenuis*), ocean pout (*Macrozoarces americanus*), Atlantic halibut (*Hippoglossus hippoglossus*), and the Southern Georges Bank/Middle Atlantic stock of silver hake (*Merluccius bilinearis*). Other stocks are in the process of being rebuilt from levels below the maximum sustainable yield, including the Gulf of Maine and Georges Bank stocks of Atlantic cod and haddock, the Cape Cod stock of yellowtail flounder, the Georges Bank stock of winter flounder, and the Gulf of Maine/Northern Georges Bank stock of silver hake (NMFS, 2002a). The status of many other stocks is poorly known. As indicated in the table, the majority of the stocks requiring management are also subject to I&E.

C2-2 I&E SPECIES AND SPECIES GROUPS EVALUATED

Table C2-3 provides a list of species evaluated by EPA that are subject to I&E in the North Atlantic region. Appendix C-1 provides the life history parameters that were used to express these losses as age 1 equivalents, foregone fishery yield, and production foregone.

Table C2-3: Species Evaluated by EPA that are Subject to I&E in the North Atlantic Region				
Species Group	Species	Recreational	Commercial	Forage
Alewife	Alewife		X	
American plaice	American plaice		X	
American sand lance	American sand lance			X
American shad	American shad		X	
Atlantic cod	Atlantic cod	X	X	
Atlantic cod	Haddock	X	X	
Atlantic herring	Atlantic herring		X	
	Hickory shad		X	
	Round herring		X	
Atlantic mackerel	Atlantic mackerel	X	X	
Atlantic menhaden	Atlantic menhaden		X	

Table C2-3: Species Evaluated by EPA that are Subject to I&E in the North Atlantic Region

Species Group	Species	Recreational	Commercial	Forage
Atlantic silverside	Atlantic silverside			X
Atlantic tomcod	Atlantic tomcod			X
Bay anchovy	Bay anchovy			X
	Striped anchovy			X
Blueback herring	Blueback herring			X
Bluefish	Bluefish	X	X	
Butterfish	Butterfish		X	
Commercial crabs	Green crab		X	
	Jonah crab		X	
	Lady crab		X	
	Lesser blue crab		X	
	Mud crab		X	
	Narrow mud crab		X	
	Spider crabs		X	
Cunner	Cunner	X		
Fourbeard rockling	Fourbeard rockling			X
Grubby	Grubby			X
Hogchoker	Hogchoker			X
Lumpfish	Lumpfish		X	
Lumpfish	Lumpsucker		X	
Other (commercial)	Goosefish		X	
	Redfish		X	
	Spot		X	
	Wolffish		X	
Other (forage)	African pompano			X
	Alligatorfish			X
	Atlantic bigeye			X
	Atlantic moonfish			X
	Atlantic seasnail			X
	Banded rudderfish			X
	Bigeye scad			X
	Black ruff			X
	Brown trout			X
	Cornet fish			X
	Creville jack			X
	Flying gurnard			X
	Glasseye			X
	Gulf snailfish			X
	Long finned squid			X
	Lookdown			X
	Mackerel scad			X
	Northern sennet			X
	Northern shortfin squid			X
	Ocean pout			X

Species Group	Species	Recreational	Commercial	Forage
	Orange filefish			X
	Oyster toadfish			X
	Pearlside			X
	Planehead filefish			X
	Rough scad			X
	Round scad			X
	Sand tiger			X
	Sea lamprey			X
	Sheepshead minnow			X
	Short bigeye			X
	Silver rag			X
	Spotfin butterflyfish			X
	Striped burrfish			X
	Trumpetfish			X
	Wrymouth			X
Other (recreational)	American eel	X		
	Atlantic torpedo	X		
	Black sea bass	X		
	Blue runner	X		
	Conger eel	X		
	Cownose ray	X		
	Dusky smooth hound	X		
	Flathead mullet	X		
	Northern puffer	X		
	Piked dogfish	X		
	Smooth dogfish	X		
	Spiny dogfish	X		
	Striped cusk-eel	X		
	White catfish	X		
	White mullet	X		
Northern pipefish	Lined seahorse			X
	Northern pipefish			X
	Seahorse			X
Pollock	Pollock	X	X	
Radiated shanny	Radiated shanny			X
Rainbow smelt	Rainbow smelt		X	
Red hake	Red hake		X	
	Spotted hake		X	
	White hake		X	
Rock gunnel	Rock gunnel			X
Sculpin species	Longhorn sculpin	X	X	
	Moustache sculpin	X	X	
	Sea raven	X	X	
	Shorthorn sculpin	X	X	

Table C2-3: Species Evaluated by EPA that are Subject to I&E in the North Atlantic Region				
Species Group	Species	Recreational	Commercial	Forage
Scup	Scup	X	X	
Seaboard goby	Seaboard goby			X
Searobin	Northern searobin	X	X	
	Striped searobin	X	X	
Silver hake	Silver hake		X	
Skate species	Clearence skate		X	
	Little skate		X	
Striped bass	Striped bass	X		
Striped killifish	Mummichog			X
	Striped killifish			X
Tautog	Tautog	X	X	
Threespine stickleback	Blackspotted stickleback			X
	Fourspine stickleback			X
	Ninespine stickleback			X
	Threespine stickleback			X
Weakfish	Northern kingfish	X	X	
	Weakfish	X	X	
White perch	White perch	X	X	
Windowpane	American fourspot flounder		X	
	Smallmouth flounder		X	
	Summer flounder		X	
	Windowpane		X	
Winter flounder	Fourspot flounder	X	X	
	Lefteye flounder	X	X	
	Righteye flounder	X	X	
	Smooth flounder	X	X	
	Winter flounder	X	X	
	Witch flounder	X	X	
	Yellowtail flounder	X	X	

Life histories of the species with the highest losses are summarized in the following section. The life history data used in EPA's analysis and associated data sources are provided in Appendix C1 of this report.

C2-3 LIFE HISTORIES OF PRIMARY SPECIES IMPINGED AND ENTRAINED IN THE NORTH ATLANTIC REGION

Alewife (*Alosa pseudoharengus*)

Alewife is a member of the herring family, Clupeidae, and ranges along the Atlantic coast from Newfoundland to North Carolina (Scott and Crossman, 1998). Alewife tend to be more abundant in the mid-Atlantic and along the northeastern coast. They are anadromous, migrating inland from coastal waters in the spring to spawn. Adult alewife overwinter along the northern continental shelf, settling at the bottom in depths of 56 to 110 m (184 ft to 361 ft) (Able and Fahay, 1998). Adults feed on a wide variety of food items, while juveniles feed mainly on plankton (Waterfield, 1995).

Alewife has been introduced to a number of lakes to provide forage for sportfish (Jude et al., 1987b). Ecologically, alewife is an important prey item for many fish, and commercial landings of river herring along the Atlantic coast have ranged from a high of 33,974 metric tons (74.9 million lb) in 1958 to a low of less than 2,268 metric tons (5 million lb) in recent years (Atlantic States Marine Fisheries Commission, 2000b).

Spawning is temperature-driven, beginning in the spring as water temperatures reach 13 to 15 °C (55 to 59 °F) and ending when they exceed 27 °C (80.6 °F) (Able and Fahay, 1998). Spawning takes place in the upper reaches of coastal rivers, in slow-flowing sections of slightly brackish or freshwater.

Females lay demersal eggs in shallow water less than 2 m (6.6 ft) deep (Wang and Kernehan, 1979). They may lay from 60,000 to 300,000 eggs at a time (Kocik, 2000). The demersal eggs are 0.8 to 1.27 mm (0.03 to 0.05 in.) in diameter. Larvae hatch at a size of approximately 2.5 to 5.0 mm (0.1 to 0.2 in.) total length (Able and Fahay, 1998). Larvae remain in the upstream spawning area for some time before drifting downstream to natal estuarine waters. Juveniles table a diurnal vertical migration in the water column, remaining near the bottom during the day and rising to the surface at night (Fay et al., 1983a). In the fall, juveniles move offshore to nursery areas (Able and Fahay, 1998).

Maturity is reached at an age of 3 to 4 years for males, and 4 to 5 years for females (Able and Fahay, 1998). The average size at maturity is 265 to 278 mm (10.4 to 10.9 in.) for males and 284 to 308 mm (11.2 to 12.1 in.) for females (Able and Fahay, 1998). Alewife can live up to 8 years, but the average age of the spawning population tends to be 4 to 5 years (Waterfield, 1995; PSEG, 1999).



ALEWIFE
(*Alosa pseudoharengus*)

Family: Clupeidae (herrings).

Common names: River herring, sawbelly, kyak, branch herring, freshwater herring, bigeye herring, gray herring, grayback, white herring.

Similar species: Blueback herring.

Geographic range: Along the western Atlantic coast from Newfoundland to North Carolina.^a

Habitat: Wide-ranging, tolerates fresh to saline waters, travels in schools.

Lifespan: May live up to 8 years.^{b,c}

Fecundity: Females may lay from 60,000 to 300,000 eggs at a time.^d

Food source: Small fish, zooplankton, fish eggs, amphipods, mysids.^c

Prey for: Striped bass, weakfish, rainbow trout.

Life stage information:

Eggs: *demersal*

- ▶ Found in waters less than 2 m (6.6 ft) deep.^d
- ▶ Are 0.8 to 1.27 mm (0.03 to 0.05 in.) in diameter.^f

Larvae:

- ▶ Approximately 2.5 to 5.0 mm (0.1 to 0.2 in.) at hatching.^f
- ▶ Remain in upstream spawning area for some time before drifting downstream to natal estuarine waters.

Juveniles:

- ▶ Stay on the bottom during the day and rise to the surface at night.^g
- ▶ Emigrate to ocean in summer and fall.^f

Adults: *anadromous*

- ▶ Reach maturity at 3-4 years for males and 4-5 years for females.^f
- ▶ Average size at maturity is 265-278 mm (10.4-10.9 in.) for males and 284-308 mm (11.2-12.1 in.) for females.^f
- ▶ Overwinter along the northern continental shelf.^f

^a Scott and Crossman, 1998.

^b PSEG, 1999.

^c Waterfield, 1995.

^d Kocik, 2000.

^e Wang and Kernehan, 1979.

^f Able and Fahay, 1998.

^g Fay et al., 1983a.

Fish graphic courtesy of New York Sportfishing and Aquatic Resources Educational Program, 2001.

Atlantic menhaden (*Brevoortia tyrannus*)

The Atlantic menhaden, a member of the Clupeidae (herring) family, is a euryhaline species, occupying coastal and estuarine habitats. It is found along the Atlantic coast of North America, from Maine to northern Florida (Hall, 1995). Adults congregate in large schools in coastal areas; these schools are especially abundant in and near major estuaries and bays. They consume plankton, primarily diatoms and dinoflagellates, which they filter from the water through elaborate gill rakers. In turn, menhaden are consumed by almost all commercially and recreationally important piscivorous fish, as well as by dolphins and birds (Hall, 1995).

The menhaden fishery, one of the most important and productive fisheries on the Atlantic coast, is a multimillion-dollar enterprise (Hall, 1995). Menhaden are considered an “industrial fish” and are used to produce products such as paints, cosmetics, margarine (in Europe and Canada), and feed, as well as bait for other fisheries. Landings in New England declined to their lowest level of approximately 2.7 metric tons (5,952 lb) in the 1960s because of overfishing. Since then, landings have varied, ranging from approximately 240 metric tons (529,100 lb) in 1989 to 1,069 metric tons (2,356,742 lb) in 1998 (personal communication, National Marine Fisheries Service, Fisheries Statistics and Economics Division, Silver Spring, Maryland, March 19, 2001).

Atlantic menhaden spawn year round at sea and in larger bays (Scott and Scott, 1988). Spawning peaks during the southward fall migration and continues throughout the winter off the North Carolina coast. There is limited spawning during the northward migration and during summer months (Hall, 1995). The majority of spawning occurs over the inner continental shelf, with less activity in bays and estuaries (Able and Fahay, 1998).



ATLANTIC MENHADEN
(*Brevoortia tyrannus*)

Family: Clupeidae (herrings).

Common names: menhaden, bunker, fatback, bugfish.

Similar species: Gulf menhaden, yellowfin menhaden.

Geographic range: From Maine to northern Florida along the Atlantic coast.^a

Habitat: Open-sea, marine waters. Travels in schools.^b

Lifespan:

- ▶ Approximately 7 to 8 years.^a

Fecundity:

- ▶ Females may produce between 100,000 to 600,000 eggs.^c

Food Source: Phytoplankton, zooplankton, annelid worms, detritus^b

Prey for: Sharks, cod, pollock, hakes, bluefish, tuna, swordfish, seabirds, whales, porpoises.^b

Life stage information:

Eggs: *pelagic*

- ▶ Spawning takes place along the inner continental shelf, in open marine waters.^d
- ▶ Eggs hatch after approximately 24 hours.

Larvae: *pelagic*

- ▶ Larvae hatch out at sea, and enter estuarine waters 1 to 2 months later.^a
- ▶ Remain in estuaries through the summer, emigrating to ocean waters as juveniles in September or October.^d

Adults:

- ▶ Congregate in large schools in coastal areas.
- ▶ Spawn year round.^b

^a Hall, 1995.

^b Scott and Scott, 1988.

^c Dietrich, 1979.

^d Able and Fahay, 1998.

Fish graphic from South Carolina Department of Natural Resources, 2001.

Females mature just before age 3, and release buoyant, planktonic eggs during spawning (Hall, 1995). Atlantic menhaden annual egg production ranges from approximately 100,000 to 600,000 eggs for fish age 1 to age 5 (Dietrich, 1979). Eggs are spherical and between 1.3 to 1.9 mm (0.05 to 0.07 in.) in diameter (Scott and Scott, 1988).

Larvae hatch after approximately 24 hours and remain in the plankton. Larvae hatched in offshore waters enter the Delaware Estuary 1 to 2 months later to mature (Hall, 1995). Juveniles then migrate south in the fall, joining adults off North Carolina in January (Hall, 1995). Water temperatures below 3 °C (37 °F) kill the larvae, and therefore larvae that fail to reach estuaries before the fall are more likely to die than those arriving in early spring (Able and Fahay, 1998). Larvae hatchout at 2.4 to 4.5 mm (0.09 to 0.18 in.). The transition to the juvenile stage occurs between 30 and 38 mm (1.2 and 1.5 in.) (Able and Fahay, 1998). The juvenile growth rate in some areas is estimated to be 1 mm (0.04 in.) per day (Able and Fahay, 1998).

During the fall and early winter, most menhaden migrate south off of the North Carolina coast, where they remain until March and early April. They avoid waters below 3 °C, but can tolerate a wide range of salinities from less than 1 percent up to 33-37 percent (Hall, 1995). Sexual maturity begins at age 2, and all individuals are mature by age 3 (Scott and Scott, 1988).

Adult fish are commonly between 30 and 35 cm (11.8 and 13.8 in.) in length. The maximum age of a menhaden is approximately 7 to 8 years (Hall, 1995), although individuals of 8-10 years have been recorded (Scott and Scott, 1988).

Atlantic silverside (*Menidia menidia*)

The Atlantic silverside is a member of the silverside family, Atherinidae. Its geographic range extends from coastal waters of New Brunswick to northern Florida (Fay et al., 1983b), but it is most abundant between Cape Cod and South Carolina (Able and Fahay, 1998). Atlantic silversides inhabit sandy seashores and the mouths of inlets (Froese and Pauly, 2001). Silversides are an important species of forage fish, eaten by valuable fishery species such as striped bass (*Morone saxatilis*), bluefish (*Pomatomus salatrix*), weakfish (*Cynoscion regalis*), and Atlantic mackerel (*Scomber scombrus*) (Fay et al., 1983b; McBride, 1995).

Atlantic silversides spawn in the upper intertidal zone during spring and summer. Spawning appears to be stimulated by new and full moons, in association with spring tides. On average, females produce 4,500 to 5,000 demersal eggs per spawning season, which may include four to five separate spawning bouts (Fay et al., 1983b). The eggs are 0.9 to 1.2 mm (0.04 to 0.05 in.) in diameter. Larvae range in size from 5.5 to 15.0 mm (0.2 to 0.6 in.) (Fay et al., 1983b). The sex of Atlantic silversides is determined during the larval stage, at approximately 32 to 46 days after hatching. Water temperatures between 11 and 19 °C (52 and 66 °F) produce significantly more females, whereas temperatures between 17 and 25 °C (63 and 77 °F) produce significantly more males (Fay et al., 1983b).

Juveniles occur in estuaries during the summer months, occupying intertidal creeks, marshes, and shore zones of bays and estuaries. Silversides typically migrate offshore in the winter (McBride, 1995). In studies of seasonal distribution in Massachusetts, all individuals left inshore waters during winter months (Able and Fahay, 1998).

The diet of juveniles and adults consists of copepods, mysids, amphipods, cladocerans, fish eggs, squid, worms, molluscs, insects, algae, and detritus (Fay et al., 1983b). Atlantic silversides feed in large schools, preferring gravel and sand bars, open beaches, tidal creeks, river mouths, and marshes (Fay et al., 1983b).

Silversides live for only 1 or 2 years, usually dying after completing their first spawning (Fay et al., 1983b). Adults can reach sizes of up to 15 cm (5.9 in.) in total length (Froese and Pauly, 2001).



ATLANTIC SILVERSIDE
(*Menidia menidia*)

Family: Atherinidae (silversides).

Common names: Spearing, sperling, green smelt, sand smelt, white bait, capelin, shiner.^a

Similar species: Inland silverside (*Menidia beryllina*).^a

Geographic range: New Brunswick to northern Florida.^a

Habitat: Sandy seashores and the mouths of inlets.^b

Lifespan: One or 2 years. Often die after their first spawning.^a

Fecundity: Females produce an average of 4,500 to 5,000 eggs per spawning season.^a

Food Source: Zooplankton, fish eggs, squid, worms, molluscs, insects, algae, and detritus.^a

Prey for: Striped bass, bluefish, weakfish, and Atlantic mackerel.^{a,c}

Life stage information:

Eggs: *demersal*

- ▶ Found in shallow waters of estuarine intertidal zones.^a
- ▶ Can be found adhering to submerged vegetation.^a

Larvae:

- ▶ Range from 5.5 to 15.0 mm (0.2 to 0.6 in.) in size.^a
- ▶ Sex is determined during the larval stage by the temperature regime. Colder temperatures tend to produce more females, and warmer temperatures produce more males.^a

Adults:

- ▶ Overwinter in offshore marine waters.^d
- ▶ Can reach sizes of up to 15 cm (5.9 in.) total length.^d

^a Fay et al., 1983b.

^b Froese and Pauly, 2001.

^c McBride, 1995.

^d Able and Fahay, 1998.

Fish graphic from Government of Canada, 2001.

Tautog (*Tautoga onitis*)

The tautog is a member of the Labridae family, found in coastal areas from New Brunswick south to South Carolina. It is most abundant from Cape Cod, Massachusetts, to the Delaware Estuary (Atlantic States Marine Fisheries Commission, 2000e). Tautog are most frequently found close to shore, preferring rocky areas or other discontinuities such as pilings, jetties, or wrecks and salinities of greater than 25 ppt (Jury et al., 1994). They generally consume mussels, small crustaceans, and other molluscs (Steimle and Shaheen, 1999).

Tautog have historically supported a primarily recreational fishery. Since 1980, landings have averaged about 3,700 metric tons (8.1 million lb), with recreational catches accounting for 90 percent of the total (Atlantic States Marine Fisheries Commission, 2000e). The majority of Tautog are harvested by hook and line from private boats (Auster, 1989); however, there are also significant charter and party boat fisheries. Although commercial landings accounted for only 8.7 percent of the total from 1982 to 1991, commercial fishing has been increasing because of higher market prices (Atlantic States Marine Fisheries Commission, 2000h). There is evidence that the fishery is declining, with lower recreational and commercial catch rates. A survey conducted in Narragansett Bay in 1994 showed the lowest abundance of tautog ever recorded. Tautog are susceptible to overfishing, particularly because they experience slow growth and reproduction and tend to be easily found near wrecks and rock piles (Atlantic States Marine Fisheries Commission, 2000e).

Tautog migrate inshore in the spring to spawn in inshore waters. Spawning generally occurs between mid-May and August, peaks in June (Auster, 1989), and primarily takes place at the mouths of estuaries and along the inner continental shelf. In Narragansett Bay, tautog are known to return to the same spawning sites in the upper estuary each year. Fecundity increases with age until approximately age 16, when it begins to decline (Steimle and Shaheen, 1999). Females between 3 and 20 years were documented to contain between 5,000 and 673,500 mature eggs. The eggs are buoyant, and hatch out in approximately 2 to 3 days (Auster, 1989).

Larvae hatch out at 2 to 4 mm (0.079 to 0.157 in.) and migrate vertically in the water column, surfacing during the day and remaining near the bottom at night. Tautog are the most abundant larval species in Narragansett Bay. As they get older, they become more benthic (Steimle and Shaheen, 1999). Small juveniles will remain in estuaries year-round, in a home range of only several hundred meters, becoming torpid over the winter (Jury et al., 1994), while larger ones will join adults in deeper water. Small juveniles prefer vegetated habitats in depths of less than 1 m (3.3 ft) and are not observed in Narragansett Bay water deeper than 9 m (30 ft). Older juveniles and adults inhabit reef-like habitats that provide some type of cover (Steimle and Shaheen, 1999).

Tautog do not tend to migrate far offshore; however, adults move to deeper water in the fall, responding to decreases in temperature. Although they move to waters as deep as 45 m (148 ft), tautog select areas with rugged topography for cover. Adults return to coastal waters and estuaries to spawn when waters warm in the spring. Maturity is reached at about 3 to 4 years of age. Age 7 tautogs in Rhode Island had mean lengths of 348 mm (14 in.) for males and 301 mm (12 in.) for females. Males may live for over 30 years, while females may live to about 25 years of age (Steimle and Shaheen, 1999).



TAUTOG
(*Tautoga onitis*)

Family: Labridae (wrasses).

Common names: tautog, blackfish, white chin, chub, black porgy.^a

Similar species: Cunner (*Tautoglabrus adspersus*).

Geographic range: Most abundant from Cape Cod, Massachusetts to the Delaware Estuary.^b

Habitat: Rocky shoals around coastal shores.^c

Lifespan: Maturity is reached at about 3 to 4 years. Maximum age of over 30 years for males, 25 years for females.^a

Fecundity: Mature females may contain between 5,000 and 673,500 mature eggs.^d

Food Source: Juveniles feed on amphipods and copepods. Adults feed mainly on blue mussels, small crustaceans, and other molluscs.^a

Prey for: Smooth dogfish, barndoor skate, red hake, sea raven, goosefish, striped bass, silver hake, bluefish, seabirds.^a

Life stage information:

Eggs: *buoyant*

- ▶ Hatch out in 2 to 3 days.^a

Larvae: *pelagic*

- ▶ Young larvae migrate vertically in the water column, surfacing during the day and remaining near the bottom at night.^a

Juveniles: *benthic*

- ▶ Small juveniles prefer vegetated areas in depths less than 1 m (3.3 ft).^a
- ▶ Larger juveniles prefer covered, reef-like habitats.^a

Adults:

- ▶ Inhabit reef-like habitats that provide some type of cover.^a
- ▶ Migrate inshore in late spring to spawn at the mouths of estuaries and along the inner continental shelf.^a

^a Steimle and Shaheen, 1999.

^b Atlantic States Marine Fisheries Commission, 2000e.

^c Scott and Scott, 1988.

^d Auster, 1989.

Fish graphic from: State of Maine Division of Marine Resources, 2001b.

Windowpane (*Scophthalmus aquosus*)

Windowpane is a member of the Scophthalmidae family (left-eye flounders) found from the Gulf of St. Lawrence to Florida, inhabiting estuarine and shallow continental shelf waters less than 56 m (184 ft) deep (Able and Fahay, 1998). They have been found in areas with muddy or sandy bottoms, water temperatures ranging from 0 to 24 °C (0 to 75 °F), and salinities of 5.5 to 36 ppt (Chang et al., 1999).

Spawning occurs over the continental shelf and in estuaries, but not in waters over 20 °C (68 °F) (Kaiser and Neuman, 1995). The timing of spawning varies with location: in Mid-Atlantic Bight waters, spawning occurs from April through December, peaking in May and October, while on Georges Bank spawning occurs during summer and peaks in July and August (Hendrickson, 2000). The estimated average lifetime fecundity of females is 100,000 eggs (New England Power Company and Marine Research Inc., 1995). Eggs are buoyant and hatch out in 8 days at a water temperature of 11 °C (52 °F) (Chang et al., 1999). Eggs and larvae are planktonic, but movements are poorly understood. Between 6.5 and 13.0 mm (0.256 and 0.512 in.), eye migration occurs and the body becomes more laterally compressed (Able and Fahay, 1998). Juveniles appear to use estuaries as nursing areas, and then move to offshore waters in the fall (Kaiser and Neuman, 1995).

Although windowpane have been found to migrate 130 km (81 miles) in a few months, most researchers agree that windowpane generally do not migrate long distances (Chang et al., 1999).

Windowpane reach sexual maturity at age 3 or 4 (Hendrickson, 2000). Adults reach a maximum length of approximately 46 cm (18 in.), and may live up to 7 years (Scott and Scott, 1988).

While windowpane has not been a particularly important commercial fish, it may become more so as stocks of summer flounder are overfished. Commercial catches began in 1943, and through 1975 windowpane was harvested as part of an industrial fishery. Landings in southern New England peaked in 1985 at 2,100 metric tons (4.6 million lb), decreased to a low of 100 metric tons (0.2 million lb) in 1995, and have remained below 200 metric tons (0.4 million lb) since then. Populations have also decreased since the 1980's, and overfishing is suspected as a main cause (Hendrickson, 2000).



WINDOWPANE
(*Scophthalmus aquosus*)

Family: Scophthalmidae (left-eye flounder).

Common names: windowpane.

Similar species: turbot (*Scophthalmus maximus*), brill (*Scophthalmus rhombus*).

Geographic range: From the Gulf of St. Lawrence to Florida.^a

Habitat: Estuarine and shallow continental shelf waters of depths less than 56 m (184 ft).^a

Lifespan: Approximately 7 years.^b

Fecundity: Average lifetime fecundity of 100,000 eggs.^c

Food Source: Young consume mysids; adults feed on sand shrimp, small fish (up to 10 cm), crustaceans, molluscs, and seaweed.

Prey for: Spiny dogfish, thorny skate, goosefish, Atlantic cod, black sea bass, weakfish, and summer flounder.^d

Life stage information:

Eggs: *buoyant*

- ▶ Eggs are buoyant and hatch out in 8 days at a water temperature of 11 °C.^d

Larvae: *pelagic*

- ▶ Eye migration occurs and the body becomes more laterally compressed.^d

Juveniles:

- ▶ Use estuaries as nursing areas, returning to offshore waters in the fall.^e

Adults:

- ▶ Reach a maximum length of approximately 46 cm.^b
- ▶ Seasonally migrate to deeper waters in late autumn to overwinter.^d

^a Able and Fahay, 1998.

^b Scott and Scott, 1988.

^c New England Power Company and Marine Research Inc., 1995.

^d Chang et al., 1999.

^e Kaiser and Neuman, 1995.

Fish graphic from NEFSC, 2001.

Winter flounder (*Pleuronectes americanus*)

Winter flounder is a benthic flatfish of the family Pleuronectidae (righteye flounders), which is found in estuarine and continental shelf habitats. Its range extends from the southern edge of the Grand Banks south to Georgia (Buckley, 1989b). It is a bottom feeder, occupying sandy or muddy habitats and feeding on bottom-dwelling organisms such as shrimp, amphipods, crabs, urchins, and snails (Froese and Pauly, 2001).

Both commercial and recreational fisheries for winter flounder are important. U.S. commercial and recreational fisheries are managed under the New England Fishery Management Council's Multispecies Fishery Management Plan and the Atlantic States Marine Fisheries Commission's Fishery Management Plan for Inshore Stocks of Winter Flounder (NEFSC, 2000). Three groups are recognized for management and assessment purposes: Gulf of Maine, Southern New England-Mid Atlantic, and Georges Bank. Management currently focuses on reducing fishing levels to reverse declining trends and rebuild stocks. The Gulf of Maine stock is currently considered overfished (NEFSC, 2000). Although improvements in stock condition will depend on reduced harvest, the long-term potential catch (maximum sustainable yield) has not been determined.

The winter flounder is essentially nonmigratory, but there are seasonal patterns in movements within the estuary. Winter flounder south of Cape Cod generally move to deeper, cooler water in summer and return to shallower areas in the fall, possibly in response to temperature changes (Howe and Coates, 1975; Scott and Scott, 1988).

Spawning occurs between January and May in New England, with peaks in the Massachusetts area in February and March (Bigelow and Schroeder, 1953). Spawning habitat is generally in shallow water over a sandy or muddy bottom (Scott and Scott, 1988). Adult fish tend to leave the shallow water in autumn to spawn at the head of estuaries in late winter. The majority of spawning takes place in a salinity range of 31 to 33 ppt and a water temperature range of 0 to 3 °C (32 to 37 °F). Females will usually produce between 500,000 and 1.5 million eggs annually, which sink to the bottom in clusters. The eggs

are about 0.74 to 0.85 mm (approximately 0.03 in.) in diameter, and hatch in approximately 15 to 18 days (Bigelow and Schroeder, 1953).

Larvae are about 3.0 to 3.5 mm (0.1 in.) total length when they hatch out. They develop and metamorphose over 2 to 3 months, with growth rates controlled by water temperature (Bigelow and Schroeder, 1953). Larval growth appears to be optimal with a slow increase from spawning temperatures of 2 °C (36 °F) to approximately 10 °C (50 °F; Buckley, 1982). Larvae depend on light and vision to feed during the day and do not feed at night (Buckley, 1989b). Juveniles tend to remain in shallow spawning waters, and stay on the ocean bottom (Scott and Scott, 1988).

Fifty percent of females reach maturity at age 2 or 3 in the waters of Georges Bank, while they may not mature until age 5 in more northern areas such as near Newfoundland. Females are generally 22.5 to 31.5 cm (8 to 12.4 in.) long at maturity (Howell et al., 1992).

Winter flounder supports important commercial and recreational fisheries in the area, as it is the thickest and meatiest of the common New England flatfish (Bigelow and Schroeder, 1953). Annual commercial landings in New England declined from 17,083 metric tons (37.7 million lb) in 1981 to 3,223 metric tons (7.1 million lb) in 1994. The harvest has increased somewhat since then, rising to 5,123 metric tons (11.3 million lb) in 2000 (personal communication, National Marine Fisheries Society, Fish Statistics and Economics Division, Silver Spring, MD, January 16, 2002.). Winter flounder is ecologically important as a prey species for larger estuarine and coastal fish such as striped bass (*Morone saxatilis*) and bluefish (*Pomatomus saltatrix*) (Buckley, 1989b).



WINTER FLOUNDER
(*Pleuronectes americanus*)

Family: Pleuronectidae (righteye flounders).

Common names: Blackback flounder, lemon sole, black flounder.^a

Similar species: American plaice (*Hippoglossoides platessoides*), European plaice (*P. platessus*).

Geographic range: From the southern edge of the Grand Banks south to Georgia.^b

Habitat: Bottom dweller. Found in coastal marine waters.^c

Lifespan: May live up to 15 years.

Fecundity: Females produce between 500,000 and 1.5 million eggs annually.^a

Food source: Bottom-dwelling organisms such as shrimp, annelid worms, amphipods, crabs, urchins and snails.^a

Prey for: Striped bass, bluefish.^b

Life stage information:

Eggs: *demersal*

- ▶ Approximately 0.74 to 0.85 mm (0.03 in.) in diameter.^a
- ▶ Hatch in approximately 15 to 18 days.^a

Larvae: *semi-pelagic*

- ▶ Approximately 3.0 to 3.5 (0.1 in.) mm total length when they hatch out.^a

Juveniles: *demersal*

- ▶ Once winter flounder enter the juvenile stage, they remain benthic, preferring sandy bottomed substrates.^d

Adults:

- ▶ Females mature at ages 2 and 3.^e
- ▶ Migrate seasonally to offshore waters in the summer, and inshore waters in the winter.^b

^a Bigelow and Schroeder, 1953.

^b Buckley, 1989b.

^c Scott and Scott, 1988.

^d Grimes et al., 1989.

^e Howell et al., 1992.

Fish graphic from State of Maine Division of Marine Resources, 2001c.

C2-4 I&E DATA EVALUATED

Table C2-4 lists North Atlantic facilities in scope of the Phase II rule and the facility I&E data evaluated by EPA to estimate current I&E rates for the region. See Chapter A5 of Part A for a discussion of extrapolation methods.

In Scope Facilities	I&E Data?	Years of Data
Brayton Point (MA)	Yes	1972 - 1998
Bridgeport Harbor (CT)	No - extrapolated	
Devon (CT)	No - extrapolated	
Southern Energy-Canal LLC (MA)	No - extrapolated	
Maine Energy Recovery Company (ME)	No - extrapolated	
Manchester Street (RI)	No - extrapolated	
Mason Steam (ME)	No - extrapolated	
Millstone (CT)	Yes	1973 - 2001
Montville (CT)	No - extrapolated	
Sithe Energy-Mystic LLC (MA)	No - extrapolated	
New Boston (MA)	No - extrapolated	
New Haven Harbor (CT)	No - extrapolated	
Newington (NH)	No - extrapolated	
Norwalk Harbor (CT)	No - extrapolated	
Pilgrim Nuclear (MA)	Yes	1974 - 1999
Salem Harbor (MA)	No - extrapolated	
Saugus Resco (MA)	No - extrapolated	
Schiller (NH)	No - extrapolated	
Seabrook Nuclear (NH)	Yes	1990 - 1998
Somerset (MA)	No - extrapolated	
South Meadow Station (CT)	No - extrapolated	
William F Wyman (ME)	No - extrapolated	

C2-5 EPA'S ESTIMATE OF CURRENT I&E IN THE NORTH ATLANTIC REGION EXPRESSED AS AGE 1 EQUIVALENTS, FOREGONE YIELD, AND PRODUCTION FOREGONE

Table C2-5 provides EPA's estimate of the annual age 1 equivalents, foregone fishery yield, and production foregone resulting from the impingement of aquatic species at facilities located in the North Atlantic region. Table C2-5 displays this information for entrainment.

The lost yield estimates presented in Tables C2-5 and C2-6 are expressed as total pounds and include losses to both commercial and recreational catch. To estimate the economic value of these losses, total yield was partitioned between commercial and recreational fisheries based on the landings in each fishery. Table C2-7 presents the percentage impacts assumed for each species and the value per pound for commercially harvested species.

Table C2-5: Current Annual Impingement in the North Atlantic Region Expressed as Age 1 Equivalents, Foregone Fishery Yield, and Production Foregone

Species	Age 1 Equivalents (#s)	Total Yield (lbs)	Production Foregone
American plaice	1	0	0
American sand lance	54,035	0	12
American shad	0	0	0
Atlantic cod	1,177	385	135
Atlantic herring	6,935	981	574
Atlantic mackerel	2	0	0
Atlantic menhaden	589	69	51
Atlantic silverside	823,743	0	166
Atlantic tomcod	10	0	0
Alewife	28,500	0	541
Bay anchovy	25,035	0	3
Blueback herring	3,280	0	150
Bluefish	12	18	8
Butterfish	11,894	194	198
Crabs (commercial)	42,616	310	335
Cunner	2,399	11	13
Fourbeard rockling	30	0	0
Grubby	39,222	0	101
Hogchoker	15,649	0	7
Lumpfish	5,192	596	137
Other (commercial)	62	12	8
Other (forage)	81,858	0	9
Other (rec. and com.)	1,167	227	150
Other (recreational)	612	119	79
Northern pipefish	13,099	0	12
Pollock	27	39	12
Radiated shanny	520	0	0
Rainbow smelt	41,440	0	248
Red hake	193	59	45
Rock gunnel	6,225	0	28
Sculpins	5,116	314	214
Scup	239	38	25
Searobin	1,376	51	82
Silver hake	2,772	363	249
Skates	4,645	961	447
Striped bass	1	2	0
Striped killifish	5,005	0	31
Tautog	358	200	61
Threespine stickleback	30,097	0	8
Weakfish	128	26	13
White perch	13	0	0
Windowpane	4,306	80	197
Winter flounder	34,571	4,176	13,008

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Table C2-6: Current Annual Entrainment in the North Atlantic Region Expressed as Age 1 Equivalents, Foregone Fishery Yield, and Production Foregone			
Species	Age 1 Equivalents (#s)	Total Yield (lbs)	Production Foregone
American plaice	4,460	781	902
American sand lance	4,895,002	0	203,374
Atlantic cod	16,021	5,245	4,751
Atlantic herring	150,898	21,347	337,430
Atlantic mackerel	25,674	3,550	487,791
Atlantic menhaden	47,881	5,578	2,067,422
Atlantic silverside	25,712	0	7,487
Alewife	1,478	0	633
Bay anchovy	4,237,067	0	234,356
Bluefish	0	0	32
Butterfish	152	2	7
Cunner	5,213,386	23,512	555,300
Fourbeard rockling	1,627,524	0	29,031
Grubby	3,637,090	0	24,408
Hogchoker	109,764	0	248,461
Lumpfish	233	27	147
Other (commercial)	93	18	213
Other (forage)	47,043	0	1,721
Other (rec. and com.)	2	0	4
Other (recreational)	51	10	118
Northern pipefish	2,386	0	79
Pollock	23	33	11,046
Radiated shanny	5,405,950	0	9,406
Rainbow smelt	163,111	0	13,643
Rock gunnel	23,480,022	0	325,811
Sculpins	2,423,596	148,924	268,852
Scup	1,637	261	18,353
Seaboard goby	4,866,006	0	1,989
Searobin	12,606	465	1,910
Silver hake	2,479	324	35,277
Tautog	138,009	77,057	221,905,343
Threespine stickleback	2,098	0	89
Weakfish	1,725	352	13,928,389
White perch	0	0	232
Windowpane	25,609	477	1,060,579
Winter flounder	7,841,124	947,142	47,322,311

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C2-6 ASSUMPTIONS USED IN CALCULATING RECREATIONAL AND COMMERCIAL LOSSES

The lost yield estimates presented in Tables C2-5 and C2-6 are expressed as total pounds and include losses to both commercial and recreational catch. To estimate the economic value of these losses, total yield was partitioned between commercial and recreational fisheries based on the landings in each fishery. Table C2-7 presents the percentage impacts assumed for each species, as well as the value per pound for commercially harvested species.

Species Group	Percent Impact to Recreational Fishery^{a,b}	Percent Impact to Commercial Fishery^{a,b}	Commercial Value per Pound (2002\$)^c
Atlantic cod ^d	50.0%	50.0%	\$1.00
American plaice	0.0%	100.0%	\$1.22
American shad	0.0%	100.0%	\$0.42
Atlantic herring	0.0%	100.0%	\$0.06
Atlantic mackerel	22.2%	77.8%	\$0.22
Atlantic menhaden	0.0%	100.0%	\$0.06
Bluefish	89.1%	10.9%	\$0.28
Butterfish	0.0%	100.0%	\$0.59
Commercial crabs	0.0%	100.0%	\$0.54
Cunner	100.0%	0.0%	na
Other (commercial)	0.0%	100.0%	\$0.66
Other (recreational)	100.0%	0.0%	na
Pollock ^d	50.0%	50.0%	\$0.74
Rainbow smelt	0.0%	100.0%	\$1.04
Red hake	0.0%	100.0%	\$0.22
Sculpins	79.0%	21.0%	\$0.59
Scup ^d	50.0%	50.0%	\$1.06
Searobin	83.9%	16.1%	\$0.12
Silver hake	0.0%	100.0%	\$0.38
Skate species	0.0%	100.0%	\$0.15
Striped bass	100.0%	0.0%	na
Tautog	92.2%	7.8%	\$1.11
Weakfish	14.6%	85.4%	\$0.90
White perch	78.8%	21.2%	\$0.80
Windowpane	0.0%	100.0%	\$1.68
Winter flounder ^d	50.0%	50.0%	\$1.24
Other (forage) ^e	50.0%	50.0%	\$1.00

^a Based on landings from 1993 to 2001.

^b Calculated using recreational landings data from NMFS (2003b, <http://www.st.nmfs.gov/recreational/queries/catch/snapshot.html>) and commercial landings data from NMFS (2003a, http://www.st.nmfs.gov/commercial/landings/annual_landings.html).

^c Calculated using commercial landings data from NMFS (2003a).

^d A 50 percent, 50 percent split was assumed because landings, which largely occur in the ocean, are not considered to be an accurate indicator of impact for these species, which are largely caught near-shore.

^e Assumed equally likely to be caught by recreational or commercial fishermen. Commercial value calculated as overall average for region based on data from NMFS (2003a).

Age-1 equivalent fish that are spared from I&E are not necessarily old enough or large enough to be attractive to anglers. It may take one or more years for these fish to reach a harvestable age. For this reason, EPA discounts commercial and recreational benefits so that the cost and benefits estimates will be comparable. Tables C2-8 and C2-9 present the multiplicative discounting factors used in discounting benefits assuming a 3 percent real discount rate and a 7 percent real discount rate. For details on how these factors are developed, see Chapter A14.

Table C2-8: Factors Applied to Recreational Benefits to Implement Discounting in the North Atlantic				
Species Group	Discount Factors for Entrainment		Discount Factors for Impingement	
	3% Discount Rate	7% Discount Rate	3% Discount Rate	7% Discount Rate
Atlantic cod	0.905	0.798	0.932	0.853
Atlantic mackerel	0.901	0.790	0.928	0.845
Bluefish	0.940	0.870	0.968	0.931
Cunner	0.910	0.808	0.938	0.864
Other (recreational)	0.922	0.831	0.950	0.889
Pollock	0.880	0.750	0.906	0.803
Sculpins	0.943	0.875	0.971	0.937
Scup	0.887	0.763	0.914	0.816
Searobin	0.912	0.813	0.940	0.870
Tautog	0.728	0.486	0.750	0.520
Weakfish	0.950	0.890	0.979	0.953
White perch	0.900	0.786	0.904	0.796
Winter flounder	0.884	0.759	0.911	0.812
Other (forage)	0.919	0.829	0.919	0.829

Table C2-9: Factors Applied to Commercial Benefits to Implement Discounting in the North Atlantic

Species Group	Discount Factors for Entrainment		Discount Factors for Impingement	
	3% Discount Rate	7% Discount Rate	3% Discount Rate	7% Discount Rate
Atlantic cod	0.881	0.750	0.908	0.802
American plaice	0.840	0.677	0.865	0.725
American shad			0.893	0.773
Atlantic herring	0.879	0.749	0.905	0.802
Atlantic mackerel	0.892	0.772	0.918	0.826
Atlantic menhaden	0.930	0.847	0.958	0.906
Bluefish	0.897	0.785	0.924	0.840
Butterfish	0.934	0.856	0.962	0.916
Commercial crabs			0.976	0.947
Lumpfish	0.886	0.760	0.913	0.813
Other (commercial)	0.913	0.813	0.940	0.870
Pollock	0.832	0.664	0.857	0.711
Red hake			0.944	0.879
Sculpins	0.913	0.814	0.941	0.871
Scup	0.873	0.735	0.899	0.786
Searobin	0.884	0.758	0.911	0.811
Silver hake	0.886	0.759	0.912	0.813
Skate species			0.940	0.870
Tautog	0.720	0.475	0.742	0.508
Weakfish	0.924	0.836	0.951	0.895
White perch	0.895	0.777	0.899	0.785
Windowpane	0.810	0.618	0.883	0.756
Winter flounder	0.859	0.711	0.885	0.761
Other (forage)	0.901	0.793	0.901	0.793